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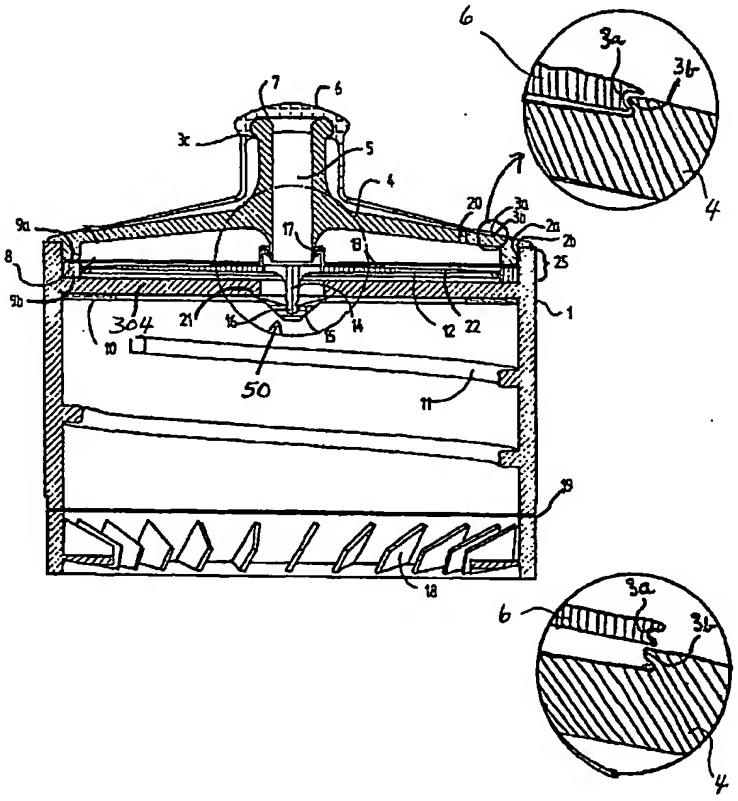
(54) Title: METHOD AND VALVE DEVICE FOR A DRINKING CONTAINER



(57) Abstract: A method and device for controlling the flow of liquid from drinking containers, wherein a membrane (12) is movably connected to a valve (50) to form a valve, controlled by negative pressure, for liquid from a drinking container, the force resulting from the pressure difference (P1 - P2) across the membrane (12), opening the valve (50), even by positive pressure (P3) within the drinking container, caused by a carbonated refreshing drink, for example.

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METHOD AND VALVE DEVICE FOR A DRINKING CONTAINER

This invention relates to a method of making a spillage-preventing valve device for a drinking container, like for example a fizzy drink container, feeding bottle, carton, bag, jug, tube, paper beaker, plastic cup or similar. The product inside the drinking container, in the following referred to as the liquid, may be an easy-flowing product such as milk, juice, fizzy drink or water, but it may also be a more viscous product such as yoghurt, soup, pudding or ice. Through suction provided by the user through the drinking spout, the flow of liquid from the drinking container is started and controlled. The flow is stopped and the drinking container automatically sealed when the suction force from the user ceases. The invention may be used for nutrients both with and without a content of carbon dioxide or other gases.

From the patent literature are known several particular devices which, besides ordinary caps, efficiently prevent liquid from flowing freely from a drinking container. Examples of such devices are US patent No. 5.975.369 and US patent No. 5.465.876. These devices do not have closing

mechanisms controlled by negative pressure, and therefore the user must carry out a mechanical movement when opening and closing the device. Moreover, the said devices are not constructed to provide good gas tightening, and thereby they are not very suitable for carbonated drinks. A device preventing leakage of liquid, even under the pressure of carbonated drinks, is also known. This is described in Norwegian patent No. 137258. This type of device enhances the force of the possible positive pressure of the liquid, with the aim of closing the valve and could therefore not be utilized for the consumption of drinks under pressure. Further, in UK patent No. 1.453.968 and in US patent No. 5.607.073 are also described devices in drinking bottles for babies. The two devices last mentioned are not spillage-proof in use because they do not utilize the pressure differential between the negative pressure supplied by the user and the positive pressure from the atmosphere to produce an automatic opening and closing of a valve.

The invention has as its object to remedy the drawbacks of known technique.

According to the invention the object is achieved through the features specified in the description below and in the following Claims.

The invention comprises the following method of making a spillage-preventing valve device for a drinking container: A membrane is disposed with a pressure seal between its outside and its inside and is connected to a valve through at least one valve stem, and through a drinking conduit it is supplied with a pressure difference (P1 - P2) between its outside and inside, the pressure difference supplying the membrane with a

force which imparts a movement to the membrane, which is transmitted to at least one valve which opens to liquid flow for as long as the pressure difference (P1 - P2) is maintained.

A device based on this method may be secured permanently to, or be removably attached to, the drinking container, or it may be formed as part of the drinking container. For example, the device may communicate with a valve through at least one valve stem, which may move at least one associated valve from a closed position into an open position by means of a movable membrane which is disposed in a pressure-sealing manner against a partition that is formed by the extension of the stationary region of the at least one valve, and at a distance from the partition, whereby a suction chamber is provided between the membrane and the partition. The suction chamber is connected to a drinking conduit leading out of the device, so that the device is activated in that air is sucked out of the suction chamber through the said drinking channel, and that, consequently, a negative pressure P2 is created inside the suction chamber relative to the surrounding pressure P1 of the membrane, so that the membrane is moved towards the partition, whereby the at least one valve stem moves the movable parts of the valve, thereby opening to liquid as long as there is a sufficient negative pressure P2 within the suction chamber.

Alternatively the device may communicate with a valve through at least one valve stem or at least one strut which may move at least one associated valve between a closed position and an open position by means of a deformable or movable membrane, which is placed, in use, by one end in a pressure-sealing manner against the user's mouth and at the same end

is fixedly secured to an outer cap, and which is connected at its other end to the fixed part of the valve. The region which is defined by the user's mouth and the internal side of the membrane in use, provides a suction chamber, so that the device is activated in that air is sucked out from the suction chamber, and that, consequently, relative to the surrounding pressure P1 of the membrane, a negative pressure P2 is created inside the pressure chamber, so that the membrane changes its shape and length, whereby the valve is moved or deformed, thereby opening to liquid as long as there is sufficient negative pressure P2 inside the suction chamber.

When the said valve devices are used for liquids under pressure, e.g. carbonated refreshing drinks, the area of the membrane surface subjected to negative pressure must be substantially larger than the valve head surface subjected to positive pressure, in order for the force achieved when the user applies a moderate negative pressure to the suction chamber, to be sufficient to open the valve even by a relatively high positive pressure inside the drinking container.

The valve head may be made of a soft material or be provided with a separate adapted seal to seal against the valve seat. For the centring of the valve, guides may be formed from the valve opening, possibly valve surfaces angled towards the centre are used, so that the valve will have a function like a plug. A cross-shaped or tubular valve stem may also be used to achieve a simple centring of the valve head. The valve head may possibly be secured to a ball joint, so that it may move enough, relative to the valve stem, to compensate for possible irregularities in the valve opening. Alternatively,

the valve may be formed as a spiral, the spiral preferably being formed in the same piece as the cap or the drinking container. The valve may possibly be made as one or more fully or partially perforated slot openings, the area with the slot openings preferably being given a shape that will aid the sealing of the slots by a positive pressure within the container. On first-time use, the partially perforated slot openings may be brought to full perforation by the force supplied by the user (Figs. 12a, b).

The valve device may be provided with a top lid, which has one or more conduits which are connected in a pressure-sealing manner to a drinking spout or teat. The top lid is fixedly mounted in a possible valve housing of the device. The pressure-sealing connection between the membrane and the top lid, and the positioning of the drinking spout do not have to be centred, as shown in the following drawings. In some cases it may be of advantage for the spout to be placed closer to the edge of the drinking container or the cap, e.g. when used on a drinking container with a large top surface, for example a cup or a beaker. In the embodiments of the invention shown it is convenient to have at least one vent in the top lid to ensure that the top surface of the membrane is always subjected to full atmospheric air pressure. The at least one hole may be adjusted in size and/or number, so that a controlled delay is achieved in the reaction time of the mechanism for switching on and off. The same adjustment may also dampen any oscillations that might occur in use. The top lid may possibly be attached to the cap and be turned in towards an adapted recess in the membrane, so that during transport and storage better protection is achieved against contaminants and physical loads. When the cap or the drinking container is to be used, the user must pull the top lid out

of its temporary support against the cap or drinking container and turn it in such a way that the drinking spout is directed outwards before the user finally presses the top lid back into its complementary, locking groove on the cap or drinking container (Figs. 19a, 19b, 19c).

To achieve increased physical strength in the whole or parts of the membrane so that the compressive forces may be conveyed in to the connected valve stem, the membrane may be equipped with ribs or formed with a similar pattern that provides a bracing effect. The membrane may also be assembled from two or several parts, so that, for example, the flexible zone which takes up the movement in use, may be of another material than the more rigid part which is to transmit the force to the valve stem.

By the use of a loose connector between the valve stem and valve head it is possible to use several valve stems, wherein one or more stems may have different lengths or configurations so that a progressive opening of the valve (Fig. 6a, b) is achieved, or possibly a sequential order of opening by the use of several valves.

It is also possible to make the valve stem or the valve stem and valve head as a loose part with a particular flexible or gliding suspension against the fixed part of the device, so that the valve stem or the valve stem and valve head may be produced in materials and shapes different from those possible if the membrane is fixed to the valve stem.

A practical embodiment, in which the method is used, may be formed by a breakable seal between the container and the cap

and a breakable seal or encapsulation over the spout or the teat.

If it is chosen to place the drinking spout directly on the membrane, a removable locking ring may be used, for example, which is placed between the outer rim of the top lid and the cap or drinking container, so that the locking ring prevents the membrane from inadvertently being compressed before the locking ring has been removed.

Another practical embodiment would be to make one or more of the parts deformable for cleaning or replacement.

It has turned out that it is possible to make variants of the device, in which, after the user has opened it through suction force, the mechanism stays open as long as there is sufficient pressure inside the bottle and sufficient flow of liquid through the mechanism to create an internal venturi effect that maintains a negative pressure P2 in the suction chamber of the mechanism.

To ensure that air will enter rigid containers when the content has been consumed, for example in bottles, it is beneficial to provide the drinking spout with a one-way choke valve, so that the negative pressure within the bottle keeps the mechanism open long enough for it to admit sufficient amounts of air into the drinking container. At the same time the device is sucked empty of remaining liquid. Through its automatic closing, the same mechanism could also work as an extra protection against impurities entering the mechanism (Figs. 15d, e).

To ensure further protection against spillage of liquid remaining in the mechanism, one or more areas on the membrane or suction chamber may be formed as at least one hollow, elastic bulge, to which, in use, the same negative pressure is supplied as to the suction chamber, and which thereby shrinks in volume in order to expand, after use, into its initial size and its initial volume, so that liquid present in the spout is sucked back into the mechanism when the pressure normalizes (increases) in the at least one bulge.

The method described herein may with advantage be used together with a continuous admission of air as the content of the drinking container is being consumed, e.g. such as shown in Norwegian patent application No. 2001 5957 (Figs. 17a and 17b, cf. Claim 15).

In the following several non-limiting exemplary embodiments of the present invention will be described. Components shown in these embodiments may moreover be used in additional combinations to those shown in the following examples. For example, all valve variants may be used in all cap variants, and all connection variants may be used on all cap variants. The examples are visualized in the accompanying drawings, in which:

Fig. 1 shows a preferred embodiment of the invention;

Figs. 1a-1b show sectional views of details of a protective cap as shown in Fig. 1;

Fig. 2 shows a section of details of a valve shown in Fig. 1;

Figs. 3a - 3b show two preferred embodiments of a bottle cap provided with a device according to the invention;

Figs. 4a-4b show in principle the operation of the present device, the device being shown, also here, positioned in a bottle cap; and

Figs. 5a - 27e show further exemplary embodiments of the present device arranged on a drinking container.

Fig. 1 shows a preferred embodiment, in which a cap 1 is provided with a valve seat 21 and a recess 25 for the fitting of a membrane 12, a valve stem 14 and a top lid 4. A valve head 15 is attached to the valve stem 14 and is tightened against the cap 1. A force F1, see Fig. 4, resulting from the difference between the pressure P1 on the top side 13 of the membrane and the pressure P2 on the bottom side 22 of the membrane is transmitted to the valve head 15 through the valve stem 14. A force F2 results from the pressure P3 within the container 23 acting on the bottom side of the valve head 15. The valve head 15 opens when F1 exceeds F2. The valve head 15 is configured in such a way, that it works at the same time as a seal against the valve seat 21 of the cap 1. Centring of the valve head 15 is provided through the configuration of the membrane 12. A joint 16 compensates for any deviation in the angle of the valve stem 14 relative to the valve seat 21 of the cap 1. The top lid 4 is provided with a drinking conduit 5 passing the liquid to a drinking spout 7. In the connection between the membrane 12 and drinking conduit 5 is used a flexible tight connection 17 which is a part in the configuration of the membrane 12. The top lid 4 is forced down into the cap 1 and is fixed when the barbs 2a of the lid engages the receivers 2b of the cap 1.

The top lid 4 forces the projecting sealing rings 9a, 9b against the outer edge 8 of the membrane, providing good sealing between the pressure zones P1 and P2. The top lid is provided with a vent 20 for pressure equalization.

A protective cover 6 may be fitted over the top lid 4. The cover 6 may be provided with an outer groove 3a that engages with a complementary tongue 3b formed in the top lid 4 (cf. Fig. 1a). When used the first time, the protective cover 6 and its groove 3a is disengaged from the top lid 4 and its tongue 3b (cf. Fig. 1b). Subsequently, the protective cover 6 may be re-engaged with the top lid 4 by means of a flange connection 3c formed between the drinking spout 7 and the protective cover 6.

Fig. 1a shows, in an enlarged section, a connection between the outer edge of the protective cover 6 and the top lid 4, the section showing that the tongue 3b and the groove 3a are of complementary shapes and are positioned in mutual engagement before the protective cover 6 is removed for the first time.

Fig. 1b shows the same section as Fig. 1a after the protective cover 6 has been removed from the top lid 4 for the first time. If put back on again, the protective cover 6 and the cap 1 are connected only by means of the flange connection 3c, and the complementary parts 3a and 3b are not engaged.

Fig. 2 shows an enlarged section of the valve 50 and the interface between the membrane 12 and the spout 5 of Fig. 1.

Fig. 3a shows in a perspective view a preferred embodiment of the device of Fig. 1 when placed on a container 23.

Fig. 3b shows in a perspective view another preferred embodiment of the device of Fig 1 and the following Fig. 5a when the device is placed on a container 23.

Fig. 4a shows in principle the operation of the present device. A force F1 resulting from the difference between the pressure P1 on the top side 13 of the membrane and the pressure P2 on the bottom side 22 of the membrane causes a movement of the membrane 12 which is transmitted to the valve head 15 through the valve stem 14. A force F2 resulting from the pressure P3 within the container 23 acts on the underside 26 of the valve head. The valve head 15 opens when F1 exceeds F2. The membrane 12 is suspended by a flexible zone 52, so that the valve 50 closes when the force F1 from the membrane 12 ceases.

Fig. 4b shows the mechanism of Fig. 4a, the valve 50 being in its open state.

Fig. 5a shows another embodiment of the device according to the invention, in which the valve 50 has a valve head 15 which is fixed to a cross-shaped valve stem 14 fixed in its turn to a membrane 12. The membrane 12 has a flexible zone 52 extended vertically all the way to the outer edge 8. The flexible zone 52 allows the membrane 12 to move vertically in use and ensures that the membrane 12 moves back up after use. In use a pressure difference is supplied across the membrane 12 and its flexible zone 52, so that buckling points 54, 56, 58 are created, shortening the length of the flexible zone 52 by virtue of the negative pressure P2, thereby providing an

additional force for the opening of the valve 50. The flexible zone may be equipped with at least one vertical reinforcement 40 which provides for the force from the buckling points to be transmitted, to the highest possible degree, to the rigid part of the membrane 12.

Fig. 5b shows the device of Fig. 5a, the valve 50 being in its open state.

Fig. 6a shows the same device as Fig. 5a, but here with an alternative embodiment of the valve 50. The membrane 12 is provided with at least one rigid strut 60, 62 and at least one flexible seal 64 which is attached to the internal surface of the cap 1 at a mounting nipple 66. When the membrane 12 is moved down towards the seal 64, the struts 60, 62 will force the outer edge 68 of the seal down, so that an opening is created. The struts 60, 62 may be of different lengths, so that all the force F1 available is first used to deform (and thereby open) only a smaller segment of the seal 64. This function is particularly useful in the opening of the valve when the internal pressure P3 within the drinking container is very high.

Fig. 6b shows the device of Fig. 6a, the valve 50 being in its open state. The strut 60 provides good opening, whereas the strut 62 is only about to open. On further admission also the strut 62 will open its assigned zone of the seal 64.

Fig. 7a shows the device of Fig. 6a provided with another type of valve 50. Here the valve stem 14 is formed as a tube fixed to the membrane 12 and terminated at its opposite end by a valve head 15. The valve stem is provided with at least

one opening 80, allowing the liquid to enter and flow through the tubular valve stem 14.

Fig. 7b shows the device of Fig. 7a, the valve 50 being in its open state.

Fig. 8a shows the device of Fig. 6a, but with the use of another type of valve 50. The valve stem 14 is attached to the membrane 12 at a cross 84. The valve head 15 is formed by a helical part of the cap 1 itself. During storage the spiral will be compressed by the pressure P3 within the drinking container and by the possible pre-tensioning of the spiral. When the valve stem 14 presses on the centre of the spiral by a sufficient force F1, the spiral will expand and thereby open to liquid flow.

Fig. 8b shows the device of Fig. 8a, the valve 50 being in its open state.

Fig. 9a shows the device of Fig. 5a, but with the use of another valve 50. The valve head 15 is formed as part of a cross-shaped valve stem 14, the sealing 88 being a part of the cap 1. Here, the force F2 acting on the valve head 15 by a positive pressure within the drinking container will propagate to the top lid 4 as the surfaced 90 and 92 are forced against each other.

Fig. 9b shows the device of Fig. 9a, the valve 50 being in its open state.

Fig. 10 shows an example of how all the above-mentioned embodiments of the invention may be used directly on a suitable drinking container 23.

Fig. 11a shows the device of Fig. 6a, placed directly on a drinking container 23, the valve 50 consisting of supported seal 64 suspended off centre, so that the membrane 12 may be formed with one centred strut 60. This embodiment facilitates mechanical assembling of the elements or manual retrofitting of the solution, e.g. when used on a compression container. This solution also provides good utilization of the force F1 from the membrane 12 as only a smaller part of the seal 64 must be deformed in order for it to open. By a lower pressure P3 in the drinking container the seal 64 will open a larger area by the same admission because the force F2 compressing it, is smaller.

Fig. 11b shows the device of Fig. 11a, the valve 50 being in its open state.

Fig. 12a shows the device of Fig. 11a provided with another type of valve 50, the valve surface consisting of a completely or partially perforated cross 96, which yields and thereby opens to liquid flow when the valve stem is forced against the cross 96 at a sufficient force F1. When the force F1 of the valve stem decreases, the cross will close to fluid flow again. The area 98 where the cross is formed, is directed in towards the drinking container to achieve a substantial increase in the tolerance of the valve to the pressure P3 of the drinking container 23.

Fig. 12b shows the device of Fig. 12a, the valve 50 being in its open state.

Fig. 13a shows another embodiment of the invention, in which the membrane 12 is arranged with a drinking spout 7. Without the use of a top lid covering the membrane, the risk of inadvertent opening of the mechanism increases. Thereby it is advantageous to use one or more braces 100 round the flexible zone 52 of the membrane, the brace(s) being of such configuration that it (they) provide(s) high strength against vertical compression, but at the same time has (have) low tolerance to bending when the flexible zone of the membrane is sucked horizontally inwards towards the centre of the device.

Figs. 13a' and 13b' show enlarged sections of the membrane 12 and braces 100 of Fig. 13. Here, the braces 100 are shown in their inactive position, in which they will serve, by an external load on the top side of the membrane, to lock against vertical compression, in that the braces 100 will then buckle in a natural manner out from the central point of the device, the surfaces 320 and 321 thereby colliding, preventing further movement of the membrane 12.

Fig. 13b shows the above-mentioned device, the valve 50 being in its open state. The membrane is forced down and the flexible zone 52 of the membrane is deformed towards the central point of the device. The braces 100 have little resistance to collapsing when subjected to load in the horizontal direction, and here they have yielded together with the flexible zone 52 of the membrane 12. The membrane 12 is shown attached to the cap 1.

Fig. 13b' shows an enlarged section of the above-mentioned device.

Fig. 14 shows a device corresponding to that in Fig. 13a, but provided here with a protective rim 110 preventing the flexible zone 52 of the membrane from being depressed inadvertently in the horizontal direction by the user, and/or preventing the zone 52 from expanding if the user is blowing into the drinking spout 7.

Fig. 15a shows a device corresponding to that shown in Fig. 13a, but here with a flexible zone 52 which forms a larger part of the membrane 12. The membrane 12 is not attached to the cap 1 in any other way than through the valve stem 14 and the valve head 15. To prevent inadvertent opening and contamination of the mechanism, the device is provided with a removable cover 6.

Fig. 15 b shows the above-mentioned device after removal of the cover 6.

Fig. 15c shows the above-mentioned device, the valve 50 being in its open state.

Fig. 15d shows the above-mentioned device, but with a modified drinking conduit 5. Here, the drinking conduit 5 is provided with at least one flexible flipper 120 which prevents remaining liquid in the mechanism from running out when the device is not in use. The at least one flipper 120 may also form a one-way coke mechanism which provides for the negative pressure that arises when the content of the bottle is being consumed, to last across the mechanism, keeping it in its open state for a while after the user has stopped sucking, so that air is admitted gradually into the bottle, and so that the mechanism is sucked empty of remaining liquid. The at least one flipper will also work as an extra

protection against the entrance of insects, for example, into the mechanism. The same method may be used in all variants of the invention.

Fig. 15e shows the above-mentioned device, the valve 50 being in its open state.

Fig. 16a shows a device corresponding to that in Fig. 15b, but the membrane 12 has a differently configured flexible zone 52 and a connection 126 directly on a drinking container 23.

Fig. 16b shows a device corresponding to that in Fig. 16a, but configured here in such a way that it is folded into the drinking container 23 before use. Before the liquid may be consumed, the protective seal 120 is pulled off and the folded in drinking mechanism is forced or pulled out, so that the mechanism projects from the drinking container 23 when the liquid is being consumed.

Fig. 16c shows the above-mentioned device in an unfolded state.

Fig. 17a shows a device corresponding to that in Fig. 16a, but with a differently configured flexible zone 52. By configuring the flexible zone 52 as a bellows, the effective travel length may be made so long that the mechanism may unfold by itself when the user pulls the sealing 120 off. Here, the device is shown, folded into the drinking container 23.

Fig. 17b shows the above-mentioned device in the unfolded state.

Fig. 17c shows a device corresponding to that in Fig. 17a, but here the mechanism is shown mounted externally on the drinking container 23.

Fig. 18a shows a device corresponding to that in Fig. 17c, but here the mechanism is shown to be mounted externally on e.g. a carton of ultrapasteurized content, the carton being provided with a partially preperforated area 130. Only when the user is to start consuming the content, he/she presses the mechanism into its lower position (Fig. 18b), so that the partially preperforated area 130 of the carton opens. The seal 120 may be provided with at least one indicator pattern which is deformed or completely or partially broken when the user activates the mechanism, so that it will be visible to others if the perforated area of the container has been broken, entirely or in parts. After the preperforated area 130 has been broken, the seal 120 is removed, so that the mechanism is ready for use.

Fig. 18b shows the device of Fig. 18a, as the partially perforated area 130 is being opened by the seal of the mechanism being pressed by a finger 130. At the same time, the indicator pattern 132 is deformed, so that it will be easily visible that the partially perforated area is completely or partially broken.

Fig. 18c shows the device of Fig. 18a after the partially perforated area 130 has been broken and after removal of the seal 120. The mechanism is now closed but ready for used.

Fig. 19a shows another embodiment of the device according to the invention, in which a cap 1 is provided with a recessed central area 150, within which both the membrane 12 and the top lid 4 lie protected before use. A breakable area 140 forms a protection against contamination during storage, but becomes a gliding seal against the outside of the extended spout 144 of the of the membrane 12 in use. The outer side round the top lid 4 is formed as a seal 146, which seals against the complementary flange 148 of the cap 1 during storage. Part of the top lid 4 is formed as a ring 142, so that the user may easily pull the top lid out of the cap 1.

Fig. 19b shows the device of Fig. 19a after the top lid 4 has been turned and put back onto the cap 1. The breakable area 140 is now broken and forms a seal against the outside of extended spout 144 of the membrane 12. The seal 146 and its complementary counterpart 148 within the cap 1 are formed in such a way that they now interlock.

Fig. 19c shows the device of Fig. 19a in use. The flexible zone 52 of the membrane 12 is here positioned horizontally and is suspended as indicated in the drawings.

Fig. 20a shows another embodiment of the device according to the invention, the membrane 12 having several flexible zones 160, 161, 162, 163 and 164. The zones 161 and 163 are vertically rigid, but horizontally compressible. The zones 160, 162 and 164 are articulated in such a way that the change in length from the compression of the membrane 12 may be transmitted to the valve 50. Vertical braces 168 may be used as part of the membrane 12 to provide maximum valve effect and good transmission of force. Between the membrane 12 and valve 50 is formed a flexible seal 166, sealing

between the atmosphere and the negative pressure supplied by the user, and sealing against leakage from the drinking container in use. Here, the valve 50 consists of a valve head, a hollow valve stem 14, valve stem openings 165 and valve seat 21. Most other valve types may also be used with the above-mentioned configuration of the invention. Here, the device is shown with a cover 6 put on.

Fig. 20b shows the device of Fig. 20a, after removal of the cover 6.

Fig. 20c shows the device of Fig. 20a in use. The membrane 12 shrinks, so that the zone 162 is reduced in diameter. The angle between the upper and lower parts of the braces 168 is changed, bringing about a change in vertical length. The valve 50 will now be open as long as the force F1, which is transmitted to the valve head 15 as a result of the difference between the negative pressure P2 from the user and P1 from the atmosphere, is sufficient to overcome the force F2 of the pressure P3 on the valve head 15.

Fig. 21 shows a device resembling the device of Fig. 20a, but with the membrane 12 of a somewhat different configuration. Here, the zones 161, 162, 163 have been combined into one zone 170. In use the zone 170 will decrease in diameter, thereby providing a change in vertical length, so that the valve 50 opens.

Fig. 22a shows the device of Fig. 20a, the membrane 12, however, having another type of valve 50 and a differently formed flexible sealing ring 166 arranged thereto. Here, the valve 50 is formed like a beak 180 with slot openings 174 extending therethrough. By changing the angle of the braces

168, the degree of opening of the beak 180 will also change. By positive pressure in the drinking container the shape of the beak will provide for the valve 50 to be subjected to compression, thereby providing good sealing in a closed position.

Fig. 22b shows the device of Fig. 22a, the valve 50 being in its open position.

Fig. 22c shows the device of Fig. 22a, the valve 50 being in its open position and under continuous admission of air. When liquid leaves a rigid drinking container 23, negative pressure is created within the drinking container 23. Here, the seal 166 is configured in such a way that it opens when the negative pressure within the drinking container 23 becomes sufficiently high for a continuous admission of air to be achieved as the content is being consumed.

Fig. 23 shows the same device and valve 50 as that shown in Fig. 22a, but here it is mounted directly on a drinking container 23. The entire device may be made in one piece, also the seal 166.

Fig. 24a shows an alternative configuration of the device shown in Fig. 23. Before use, the walls on the inside 190 of the membrane are straight, and in use the inside 190 of the membrane folds and the movement is transmitted through the braces 168 to a valve 50 formed like a beak 180 through the braces 168 with through slot openings 174.

Fig. 24a' shows the device of Fig. 24a, seen from above.

Fig. 24b shows the device of Fig. 24a, the valve 50 being in its open state, the membrane 12 having changed its shape so that the beak 180 opens.

Fig. 24b' shows the device of Fig. 24b, seen from above.

Fig. 25 shows an alternative embodiment and an alternative application of the device shown in Fig. 20a. Here, the membrane 12 terminates in a connection 200 that fits a standard aerosol bottle 210. By suction on the spout 5, the valve 50 of the aerosol bottle will open. The device has an edge 204 securing it to the edge 206 of the aerosol bottle 210.

Fig. 26a shows an alternative embodiment of the device according to the invention. Two plastic foils or foils coated with plastics, which are welded together, after formation constitute both a drinking spout 7, membrane 12, valve 50, seal 230 and a drinking container 23. The seal 230 is torn off before use. During consumption the membrane 12 will be compressed. The reinforcements 234 transmit the angular change to the valve 50, which has been formed by folding the plastic foil in the valve area into a beak-like shape 180. The angular change causes the valve 50 to open. Pressure within the drinking container 23 will exert a closing force on the valve 50.

Fig. 26b shows the device of Fig. 26a in a side view. The upper area is in a sectional view to show the mechanism.

Fig. 26c shows the device of Fig. 26a, the valve 50 being in its open state.

Fig. 27a shows another embodiment of the device according to the invention. Here, the drinking spout mentioned above has been replaced with an outlet tube 250, and the bottle 23 has been replaced with a supply tube 240. Thereby, the device may be retrofitted to soft plastic containers and to other loose hoses or spouts. Internally, the cap 244 is divided by the wall 246 so that when assembled, any liquid must pass through the holes 242 and 248 of the plate 256.

Fig. 27b shows the device of Fig. 27a, in a sectional side view. A plate 256 with the valve hole 242 and the hole 248 is fitted on the cap 244. Next, a membrane 12 is fitted externally to the plate 256. The membrane 12 is also formed, at the same time, as a valve head 15 and valve stem 14. The valve stem 14 has a restriction in the middle, so that liquid may flow up through the valve hole 242 when the valve 50 opens. Externally on the membrane 12 is mounted a protective cover 270 which has a vent 20, so that atmospheric pressure is allowed to act on the outer surface of the membrane 12.

Fig. 27c shows the device of Fig. 27a, the valve 50 being in its open position. The arrows indicate the flow conditions in use.

Fig. 27d shows the device of Fig. 27a, but here with the supply tube 240 located differently and having a different configuration. The supply tube 240 is provided with threads which may be screwed into a soft drinking container, e.g. into a carton or bag.

Fig. 27e shows the device of Fig. 27a, but here the device has been provided with a drinking spout 7 and a connection 266 adapted for a drinking straw 270.

C L A I M S

1. A method of preventing inadvertent flow of liquid from a drinking container (23), comprising the use of a membrane (12), a valve (50) and a partition (), c h a r a c t e r i z e d i n that the membrane (12) is placed in a fixed relationship to the valve (50) at least at one point, and that the membrane (12) is provided with a pressure-tight disconnection () between the outside () and inside () of the membrane (12) and is put into connection with the at least one valve (50) through at least one valve stem () or at least one brace (), in use the membrane (12) being supplied with a pressure difference (P1 - P2) between its outside () and inside () through a drinking conduit (5), so that at least at one point the pressure difference (P1 - P2) imparts a motion to the membrane, which is transmitted to the at least one valve which opens to liquid flow as long as the pressure difference (P1 - P2) is maintained.

2. A valve device for a drinking container, in which the device is arranged to an outlet opening () of a drinking container () in its position of use, the valve () being arranged to control the outflow of liquid from the drinking container (), and the device comprises at least a flexible membrane () and at least one valve stem (), to which at least one valve head () is arranged together with at least one through hole () arranged in a partition () which forms a wall portion of the drinking container () or, alternatively, a wall portion of a cap (1, 244) connected to the outlet opening () of the drinking container (), the partition () also forming a partition between the device () and the interior of the

drinking container (), c h a r a c t e r i z e d i n that the outer edge () of the membrane () is placed in a pressure-sealing manner against the extension of the internal surface of the partition () and spaced from the partition (), whereby a suction chamber () is provided between the membrane () and the partition (), and that the suction chamber () is connected to a drinking conduit (5) leading out of the device, and that the said at least one valve stem (14) is connected to the membrane (12) and projects therefrom through the said at least one through hole (300) of the partition (304), whereby the said at least one associated valve head (15) is placed on the internal surface (306) of the partition (304), and the device is arranged, in its inactive position, with the valve head (15) placed in a pressure-sealing manner against the internal surface (306) of the partition (304), but the device is activated in that air is sucked out from the suction chamber (310) through the said drinking conduit (5), a negative pressure (P2) thereby being created in the suction chamber (310) relative to the surrounding pressure (P1) of the drinking container (23), the membrane (12) and the at least one valve stem (14) thereby being moved towards the partition (304), whereby the valve head (15) is moved away from the partition (304) and liquid may flow out of the drinking container (23) under the influence of the said negative pressure.

3. A valve device for a drinking container (23), the device being arranged, in its position of use, to an outlet opening (314) in the drinking container (23), the device being arranged to control the flow of liquid out of the drinking container (23) through a drinking spout (7),

and the device comprising at least a flexible membrane (12) and at least one valve stem (14) or at least one strut (168, 234), to which at least one valve (50) is arranged together with a partition (304) which forms a wall portion of the drinking container (23), or, alternatively, a wall portion of a cap (1, 244) connected to the outlet opening (314) of the drinking container (23), the partition (304) also forming a division between device and the interior (316) of the drinking container (23), characterized in that the membrane (12) communicates with the at least one valve (50) through at least one valve stem (14) or at least one brace (168, 234), which is attached to one end of the membrane (12), the membrane (12) being fixed by its other end to an outer side of the cap (1, 244), and which, in use, is placed by the same end through the drinking conduit (5) in a pressure-sealing manner against the user's mouth for the formation of a suction chamber (310), which may open the at least one associated valve (5) on the supply of a suction force,, the negative pressure (P2) caused in the suction chamber (310) relative to the pressure (P1) surrounding the membrane (12) creating a moving force on the membrane (12) which is transmitted to the valve (50), whereby the valve (50) opens and liquid may flow out of the drinking container (23) as long as the said negative pressure (P2) is maintained.

4. A device for controlling the flow of liquid from a drinking container (23), the liquid flow being controlled by the pressure difference (P1 - P2) supplied by the user on consumption of the liquid, consisting of a membrane (12), valve stem (14), valve head (15) and

cap (1, 244), characterized in that the pressure difference (P1 - P2) across the membrane (12) moves the membrane (12), the movement of the membrane being transmitted to the valve head (15) through the valve stem (14), so that liquid flow will be allowed as long as the pressure difference (P1 - P2) is maintained.

5. A device for controlling the flow of liquid from a drinking container (23), the liquid flow being controlled by the pressure difference (P1 - P2) supplied by the user on consumption of the liquid, consisting of a membrane (12), at least one valve (50) and a cap (1, 244), characterized in that the pressure difference (P1 - P2) across the membrane (12) moves the membrane (12), the movement of the membrane being transmitted to a valve (50), so that liquid flow will be allowed as long as the pressure difference (P1 - P2) is maintained.

6. A device according to one or more of the preceding claims, characterized in that in the membrane (12) there is provided at least one through membrane hole (312) leading into the said suction chamber (310), there being connected in a pressure-sealing manner to the said at least one membrane hole (312) at least a drinking conduit (5) leading out of the device.

7. A device according to one or more of the preceding claims, characterized in that the said drinking conduit (5) is connected to a top lid (4) arranged to the partition (304) or valve housing (25) and placed on the opposite side of the membrane (12)

relative to the suction chamber (310), whereby a normal pressure chamber (311) is provided between the membrane (12) and the top lid (4).

8. A device according to one or more of the preceding claims, characterized in that the membrane (12) is connected to a top lid (4) through a drinking conduit (5), so that the cap (1, 244) or drinking container (23) together with the top lid (4) forms a protection against inadvertent touching of the membrane (12).

9. A device according to one or more of the preceding claims, characterized in that the membrane (12) is provided with a drinking spout (7), so that the membrane (12) is suitable for the liquid to be consumed without the use of a top lid (4) for example.

10. A device according to one or more of the preceding claims, characterized in that the membrane (12) is provided with at least one brace (100) preventing inadvertent compression of the suction chamber (310) in that, on an external load on the top side (318) of the membrane (12), the at least one brace (100) flexes out from the central point of the device, the surfaces (320, 321) of the brace (100) thereby contacting each other, preventing further movement and compression of the membrane (12).

11. A device according to one or more of the preceding claims, characterized in that the membrane (12) has at least one flexible zone (52).

12. A device according to one or more of the preceding claims, characterized in that the membrane (12) has a flexible zone (52), which is provided with at least one vertical reinforcement (40).

13. A device according to one or more of the preceding claims, characterized in that the drinking spout (7) is formed as a teat.

14. A device according to one or more of the preceding claims, characterized in that the drinking conduit (5) is provided with at least one movable flipper (120), which closes partially to flow whenever liquid or gas moves in the reverse flow direction of the drinking spout (5), in order to form a controlled choking by the admission of air into the drinking container (23) in that the negative pressure (P2) is maintained and the valve (50) is thereby kept open while the negative pressure (P2) is sufficient.

15. A device according to one or more of the preceding claims, characterized in that the drinking spout (7) is placed off centre relative to the membrane (12).

16. A device according to one or more of the preceding claims, characterized in that the membrane (12) and the valve (50) are formed in such a way that a venturi effect is created, affecting the membrane (12) in such a way that an opening pressure difference (P1 - P2) is maintained across the membrane (12) as long as there is sufficient pressure (P3) within

the drinking container and sufficient flow through the device.

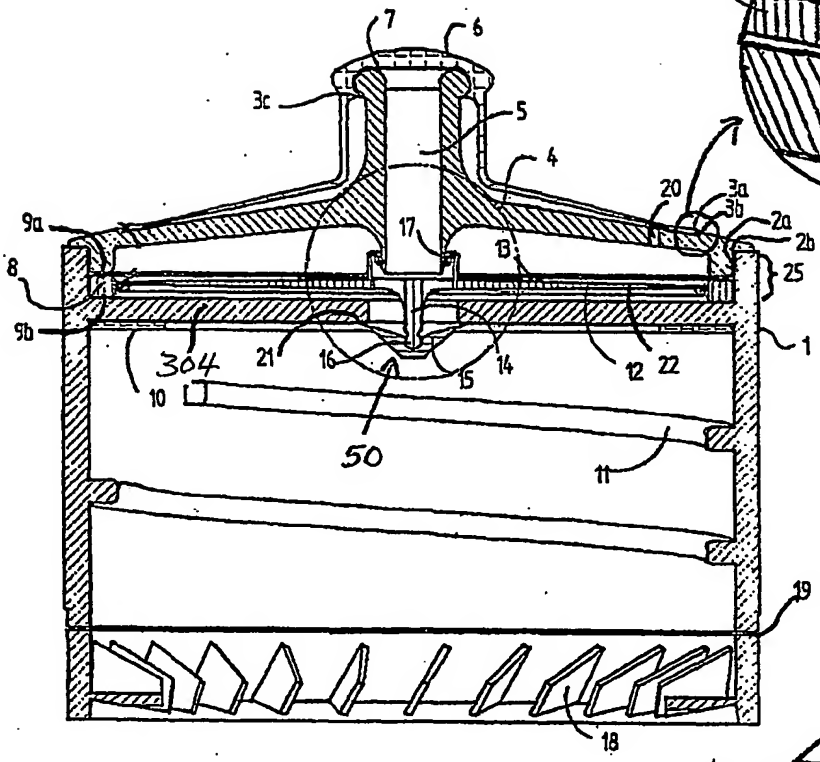

Fig. 1

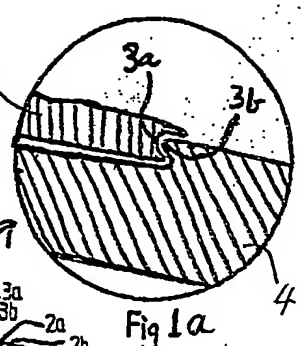

Fig 1a

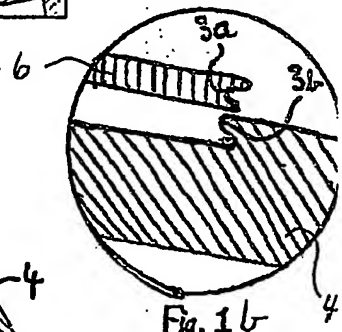

Fig. 1b

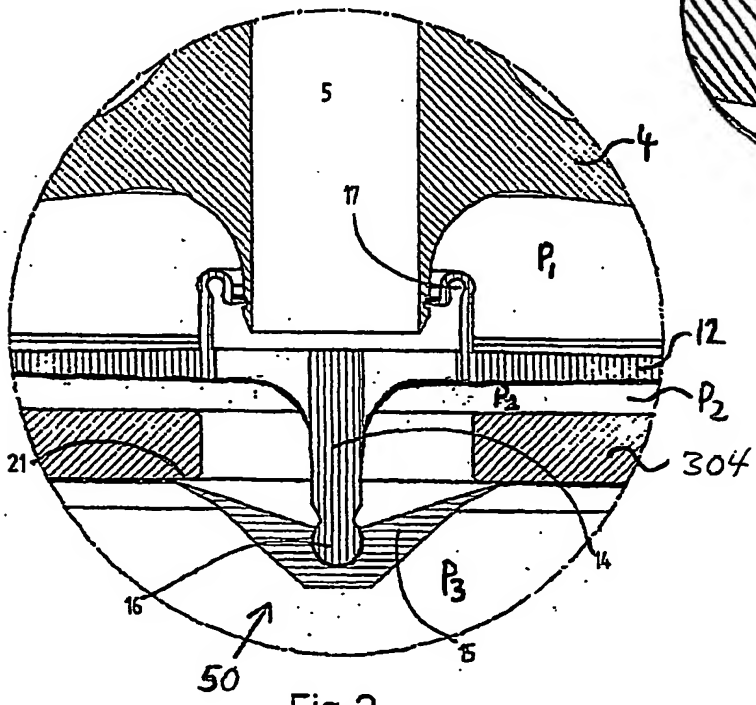

Fig 2

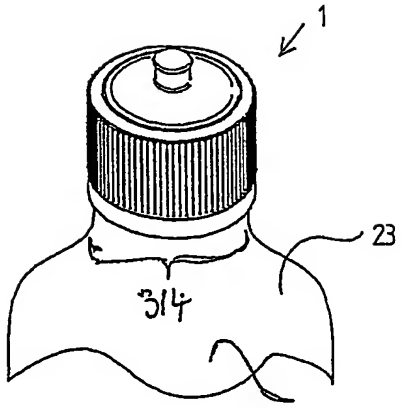

Fig. 3a

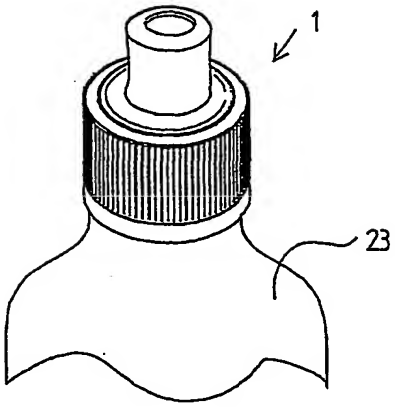

Fig. 3b

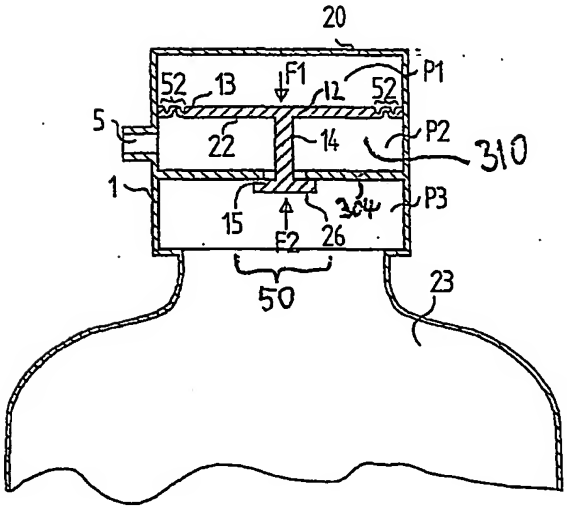

Fig. 4a

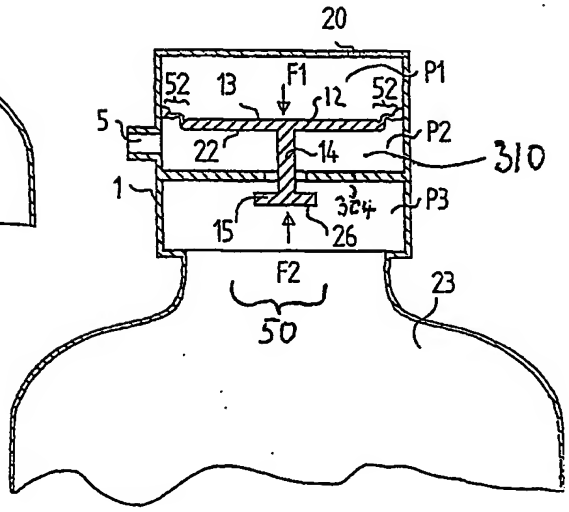

Fig. 4b

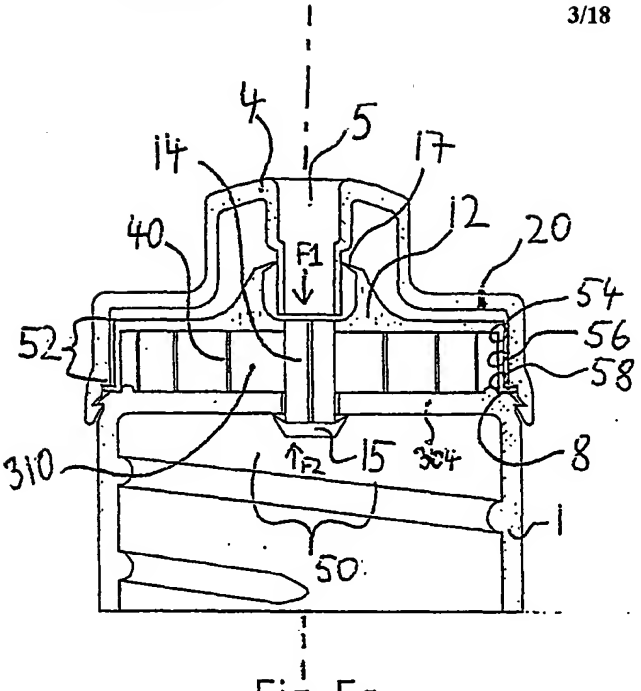

Fig. 5a

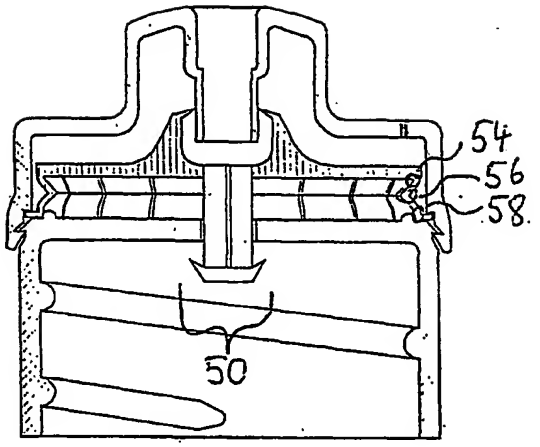

Fig. 5b

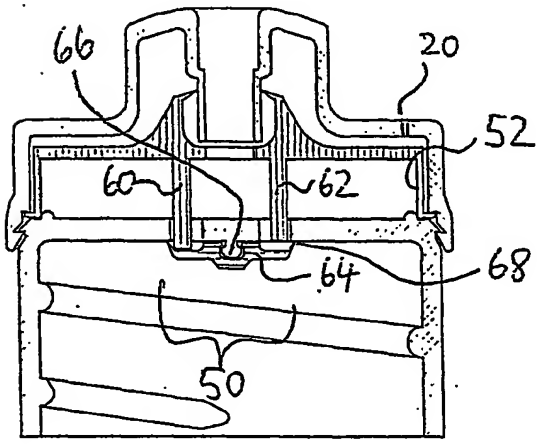

Fig. 6a

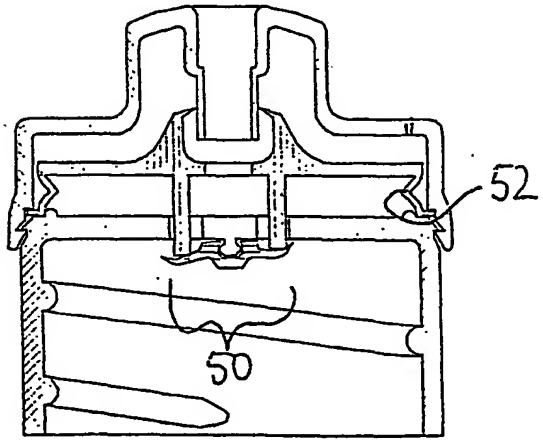

Fig. 6b

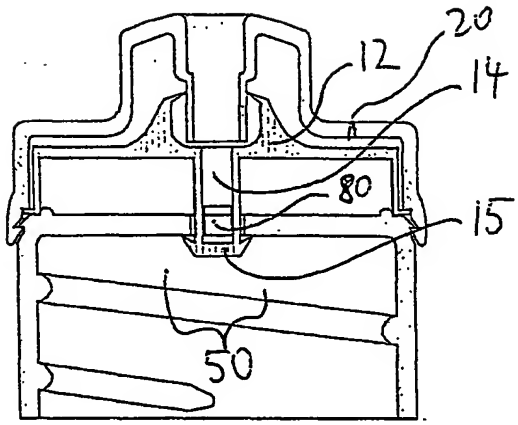

Fig. 7a

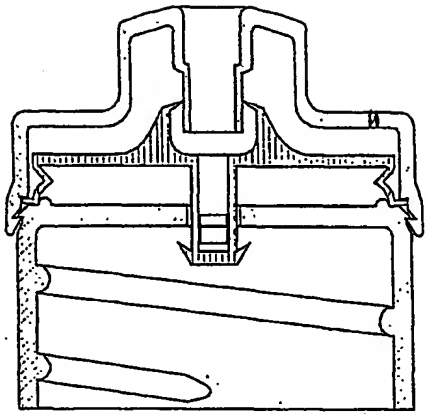

Fig. 7b

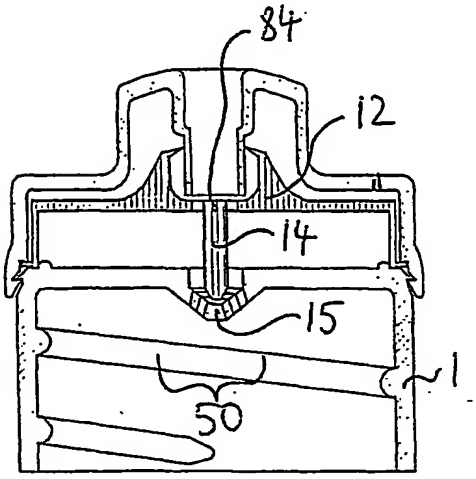

Fig. 8a

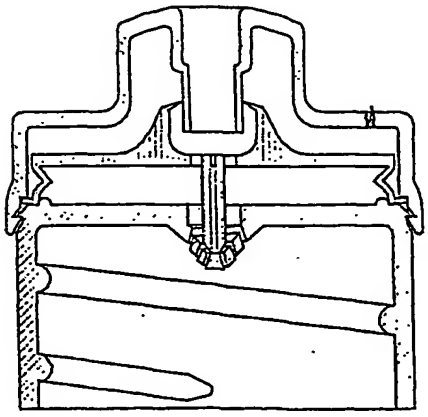

Fig. 8b

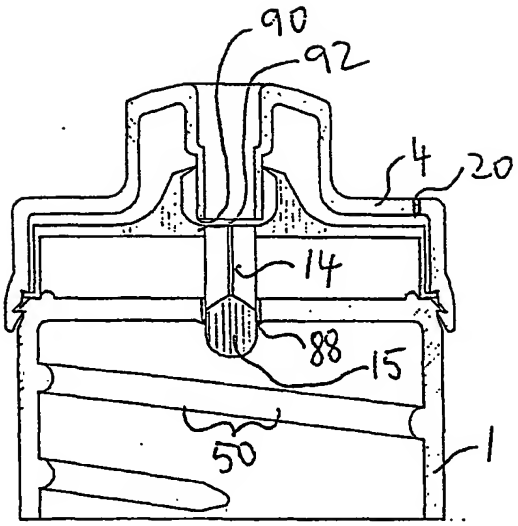

Fig. 9a

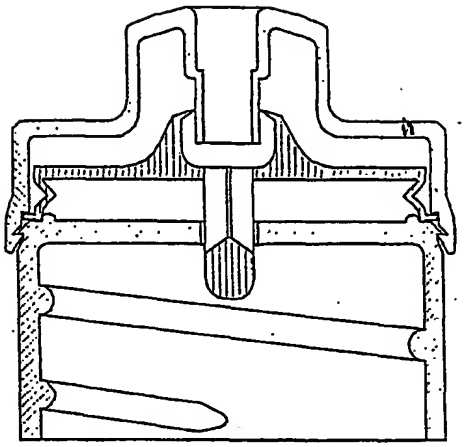

Fig. 9b

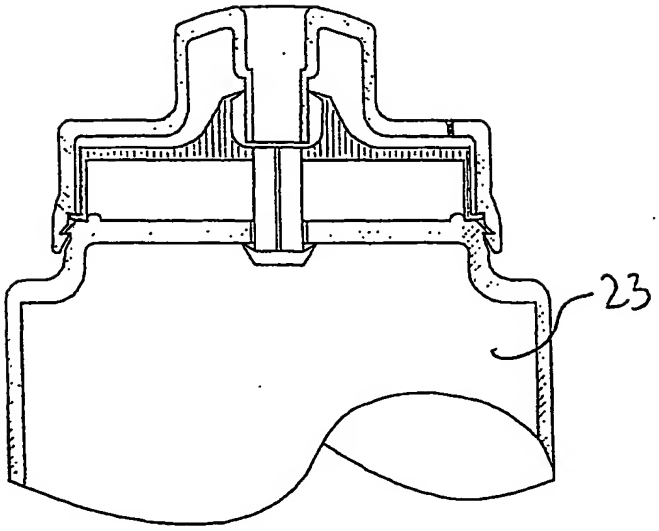

Fig. 10

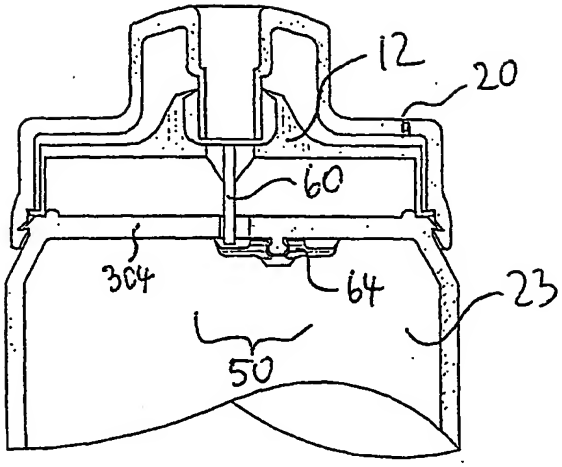

Fig. 11a

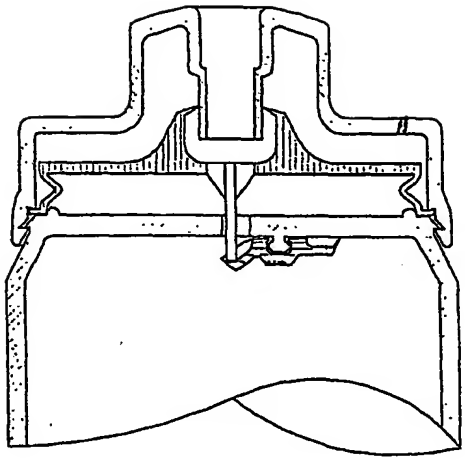

Fig. 11b

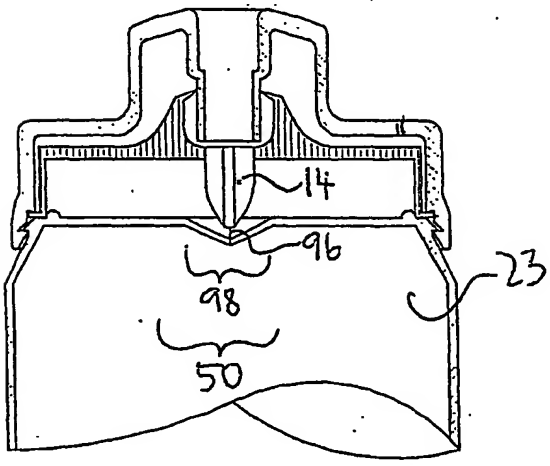

Fig. 12a

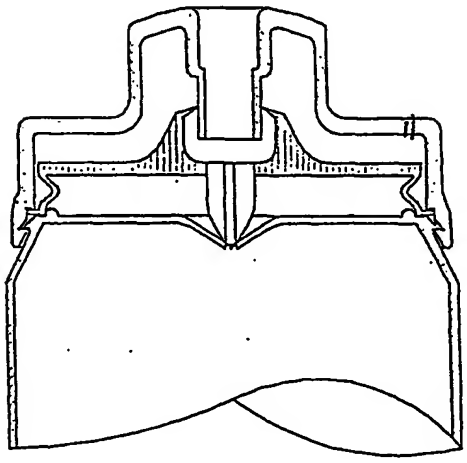

Fig. 12b

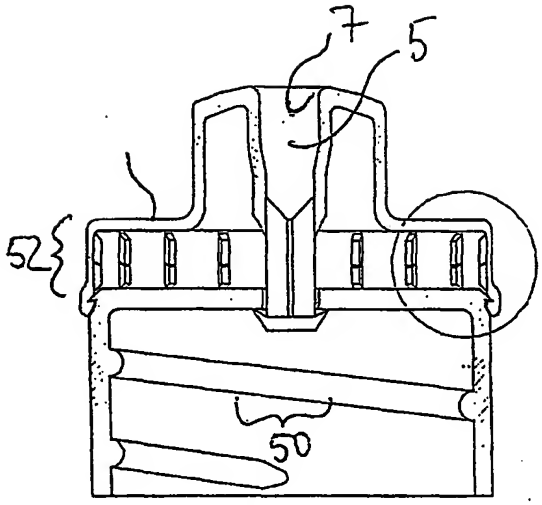

Fig. 13a

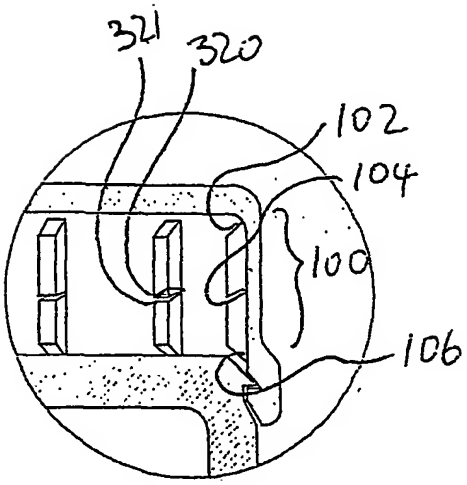

Fig. 13a'

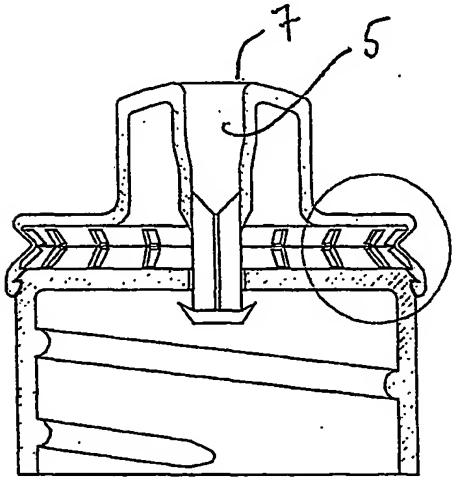

Fig. 13b

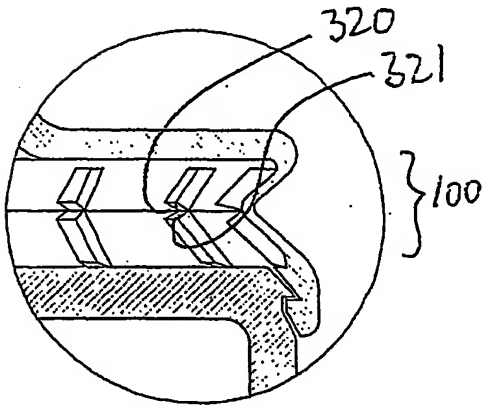

Fig. 13b'

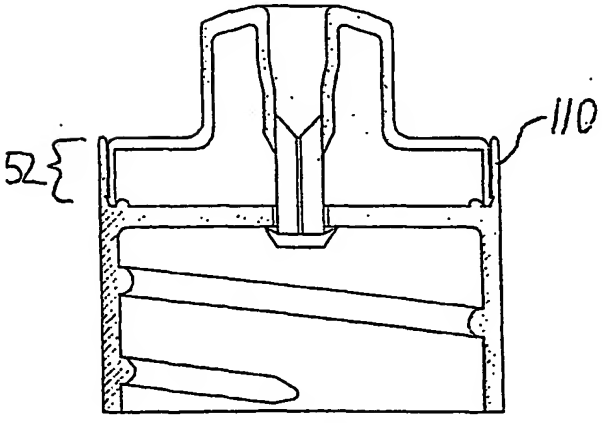

Fig. 14

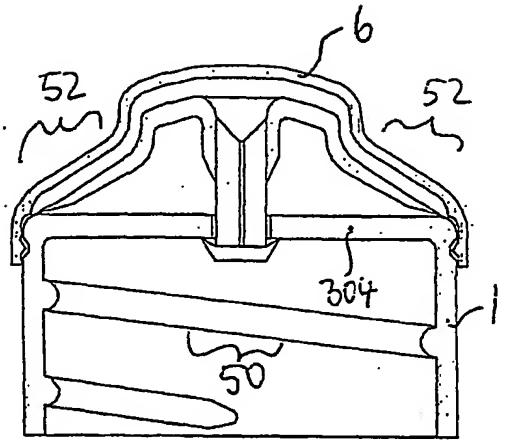

Fig. 15a

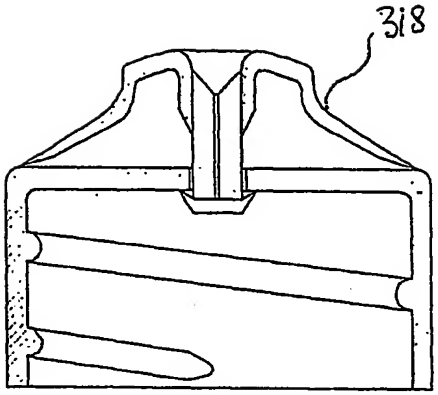

Fig. 15b

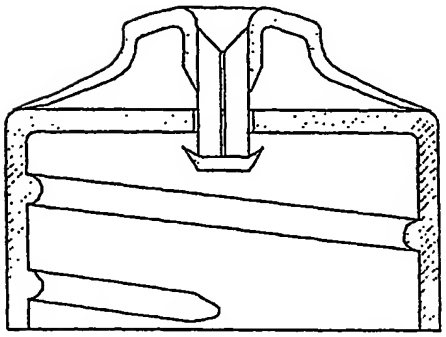

Fig. 15c

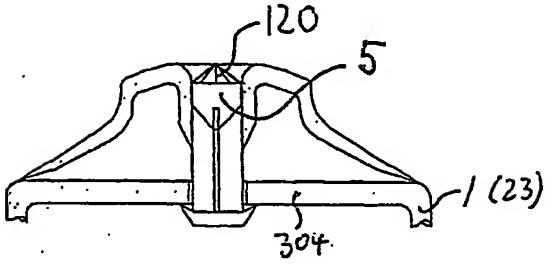

Fig. 15d

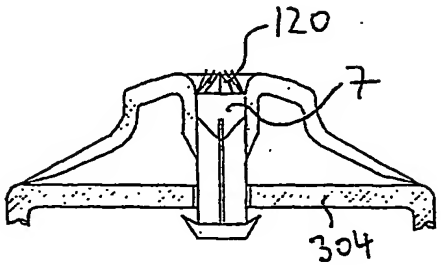

Fig. 15e

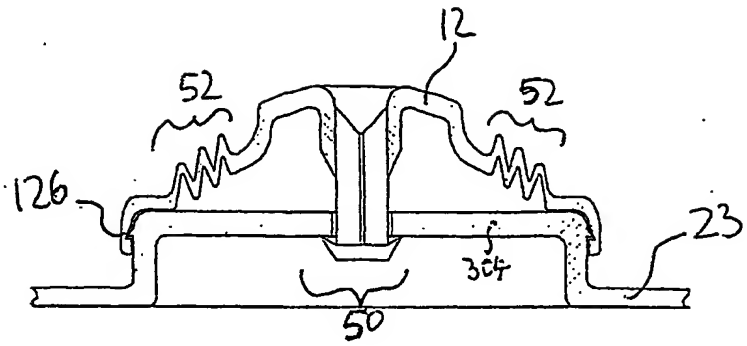

Fig. 16a

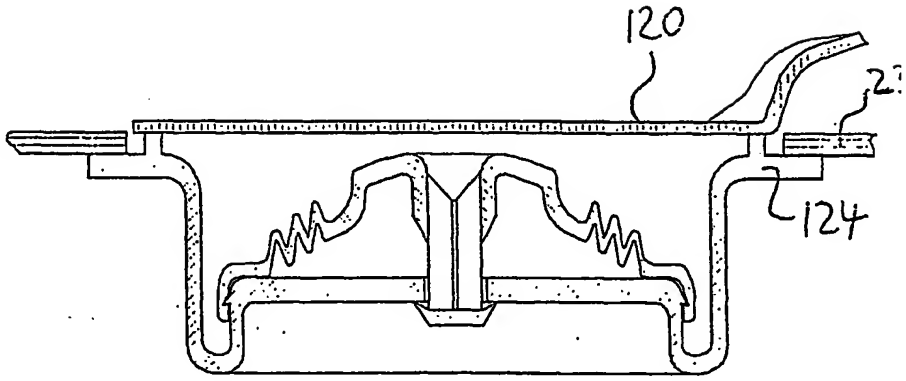

Fig. 16b

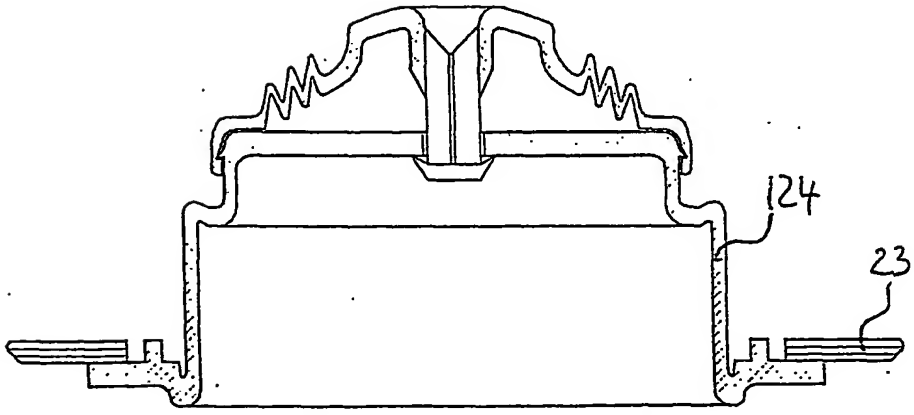

Fig. 16c

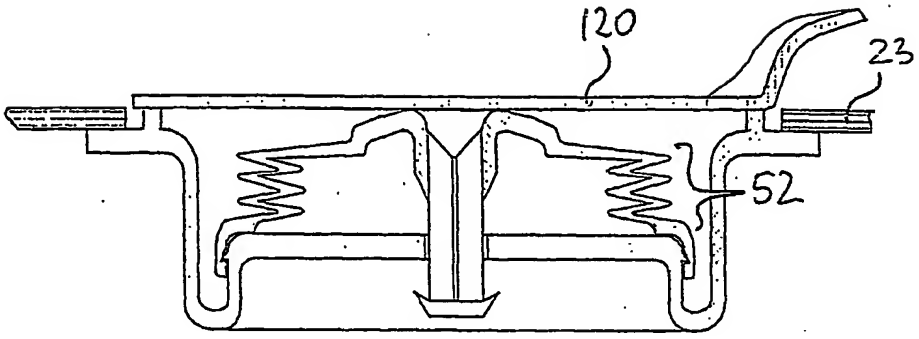

Fig. 17a

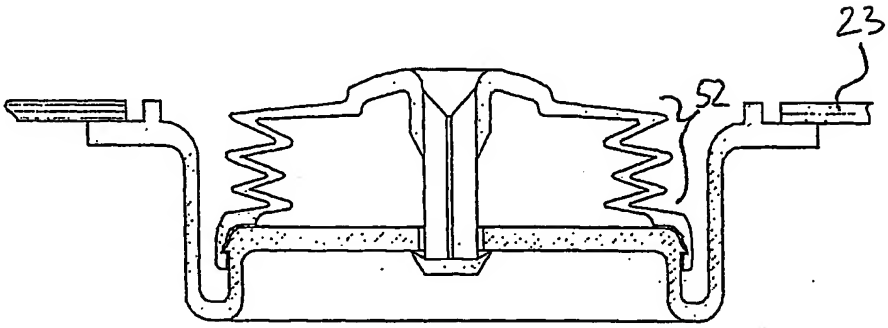

Fig. 17b

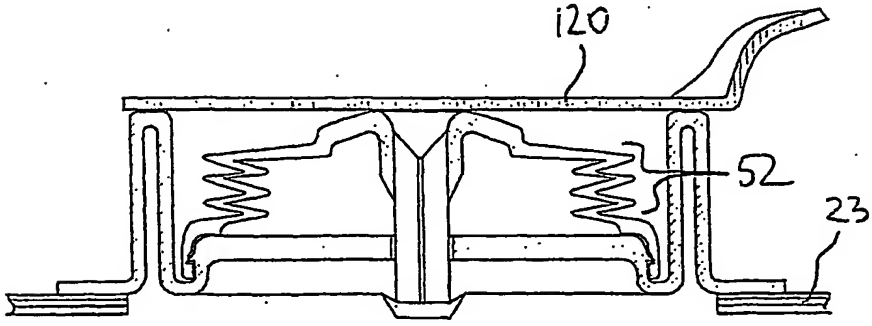

Fig. 17c

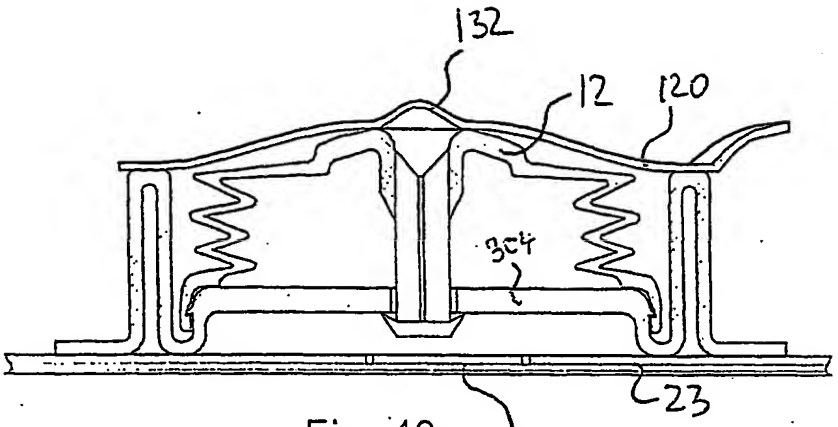

Fig. 18a

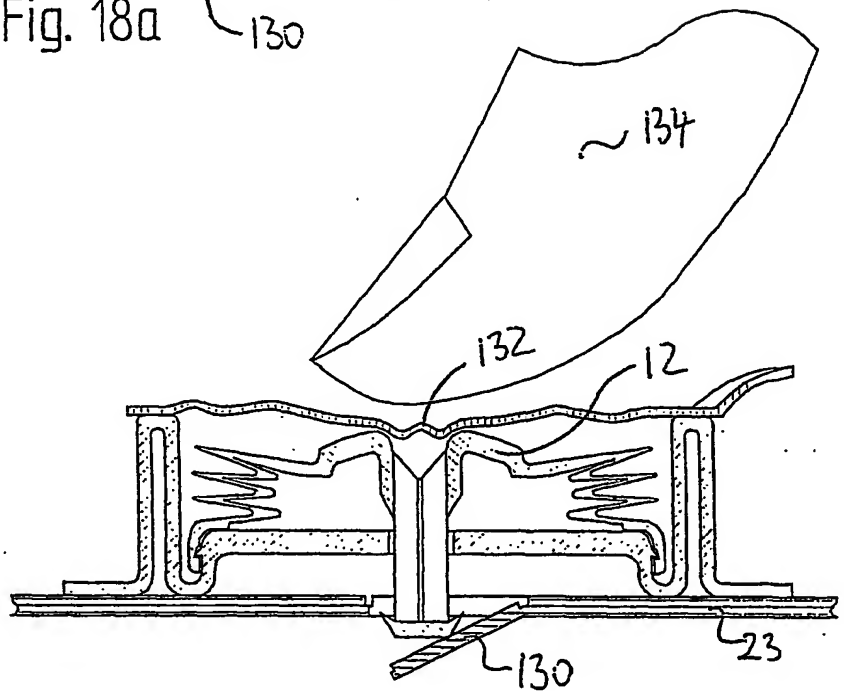

Fig. 18b

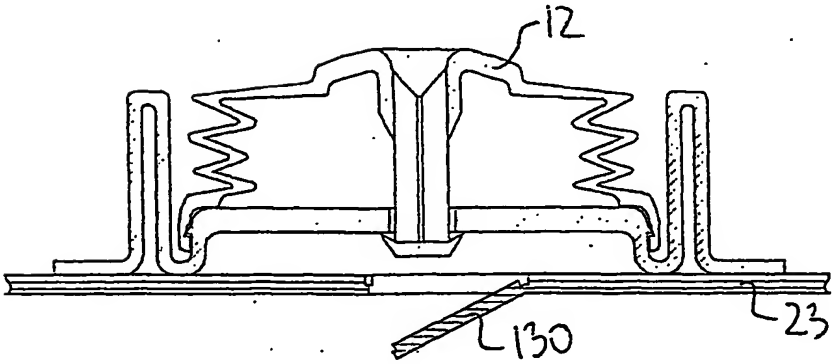

Fig. 18c

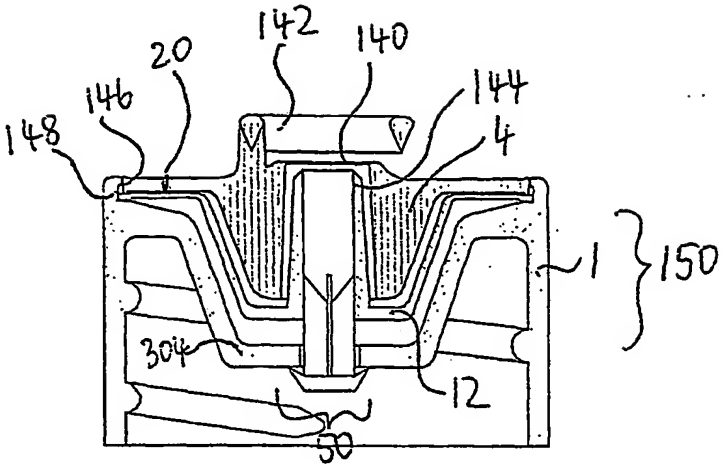

Fig. 19a

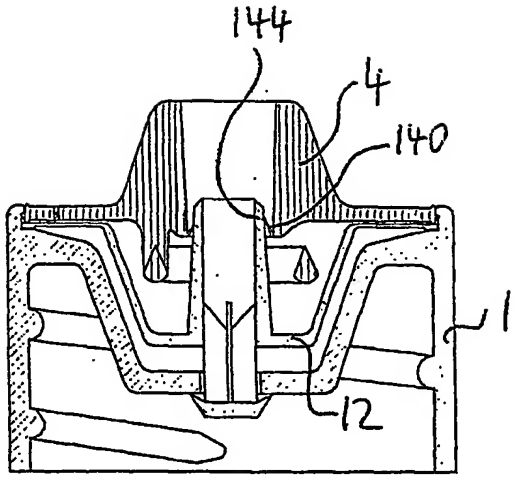

Fig. 19b

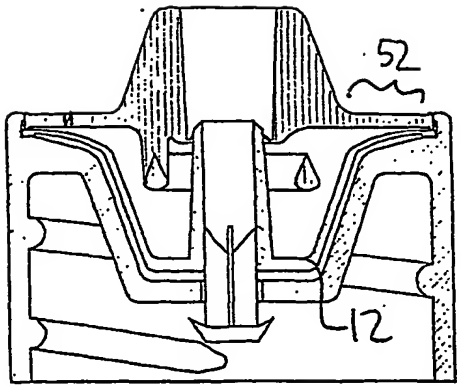

Fig. 19c

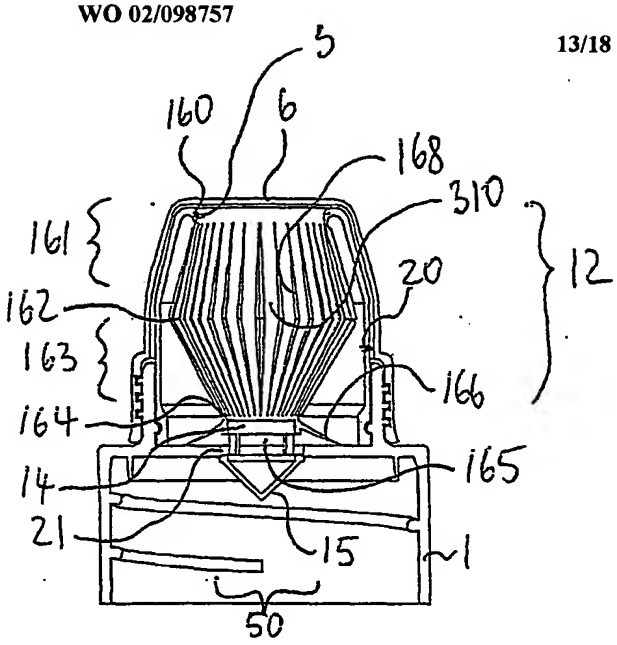

Fig. 20a

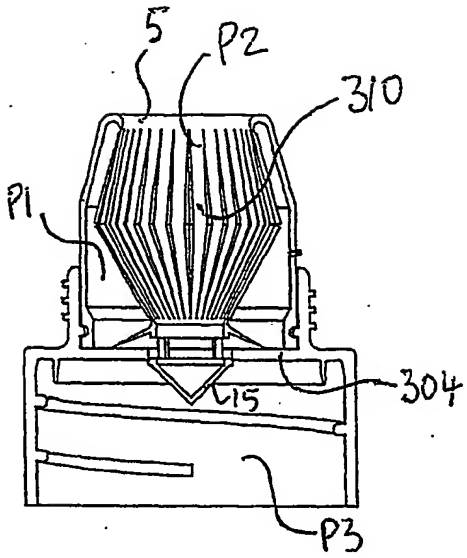

Fig. 20b

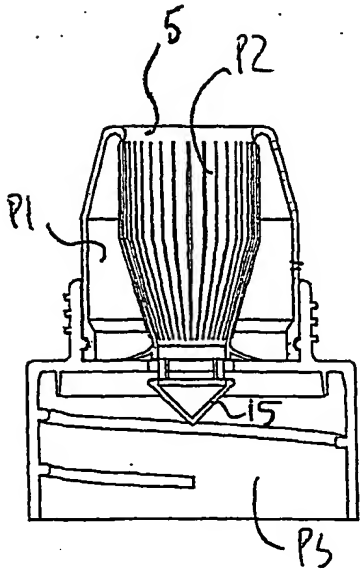

Fig. 20c

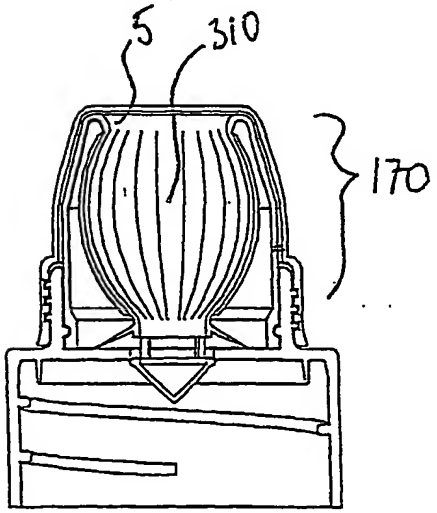

Fig. 21

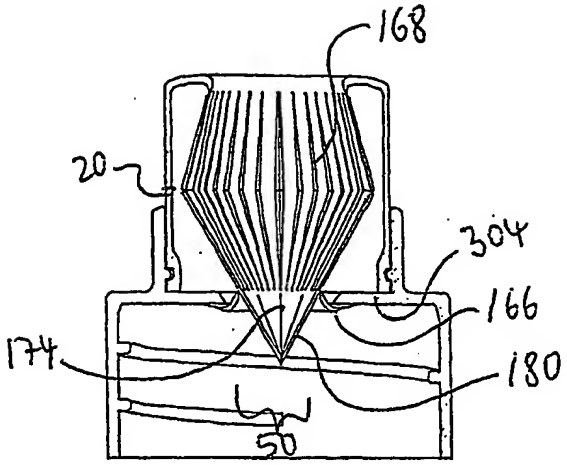

Fig. 22a

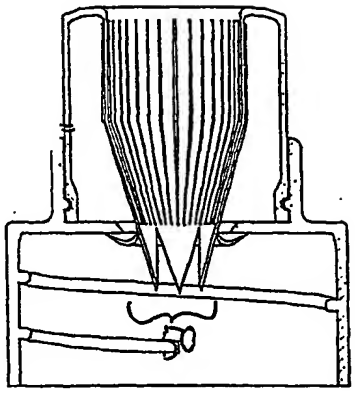

Fig. 22b

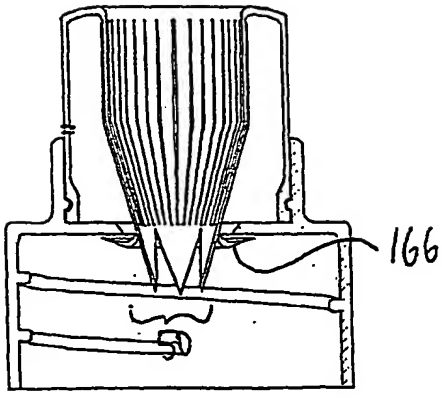

Fig. 22c

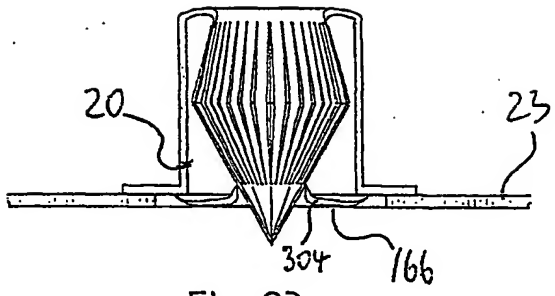

Fig. 23

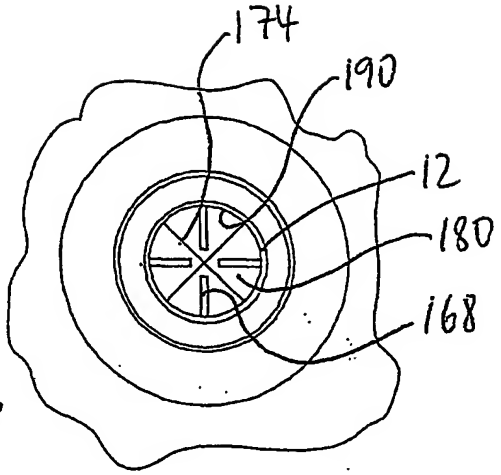

Fig. 24a'

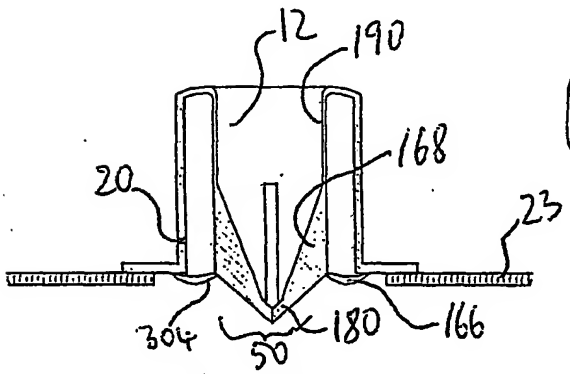

Fig. 24a

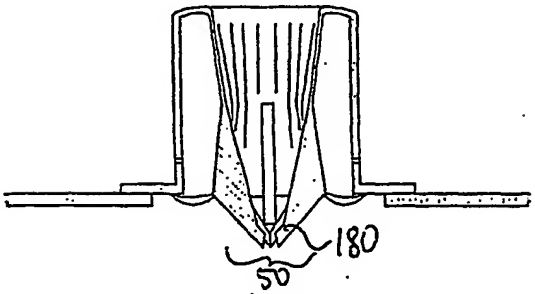

Fig. 24b

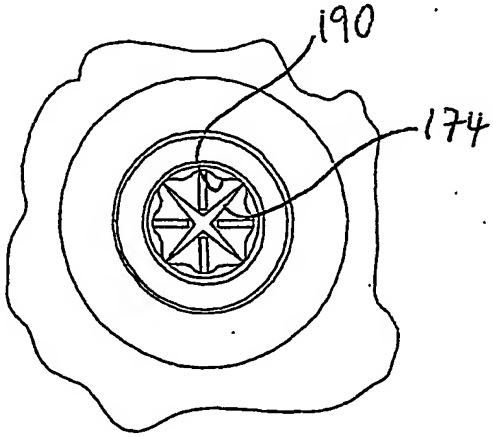

Fig. 24b'

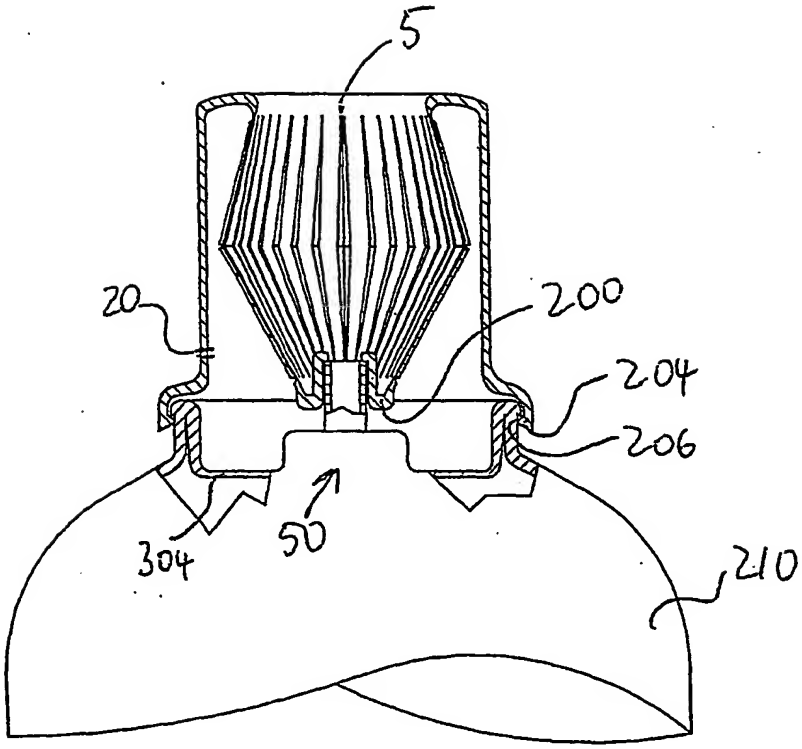

Fig. 25

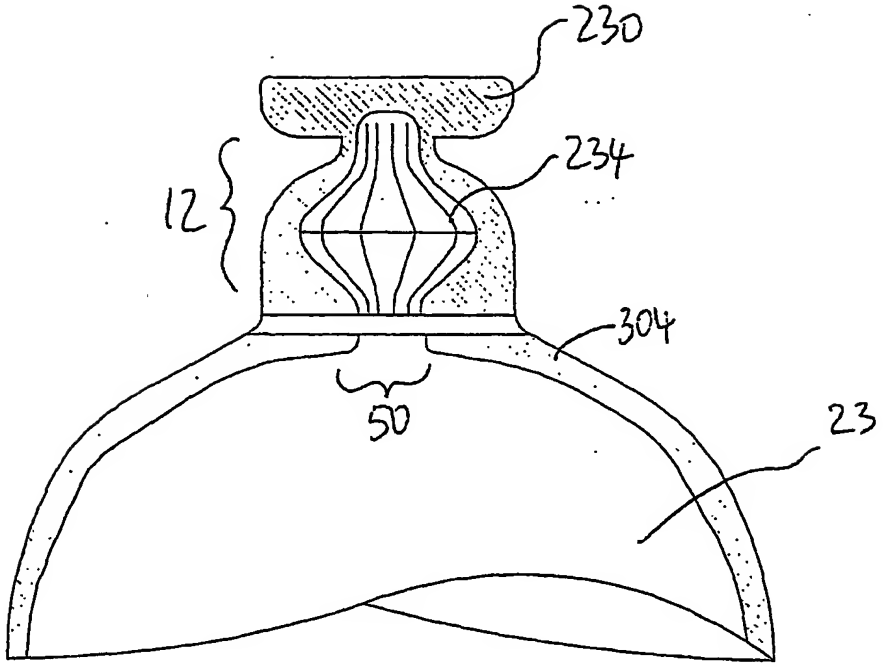

Fig. 26a

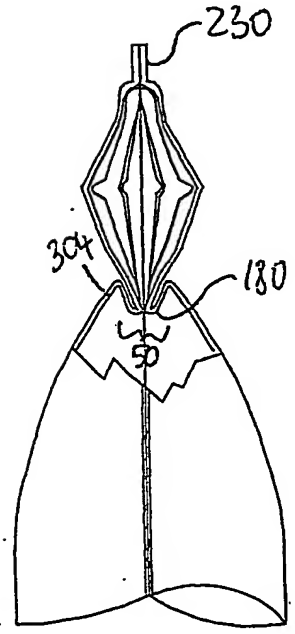

Fig. 26b

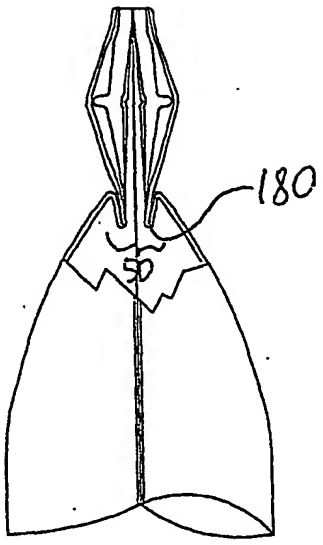

Fig. 26c

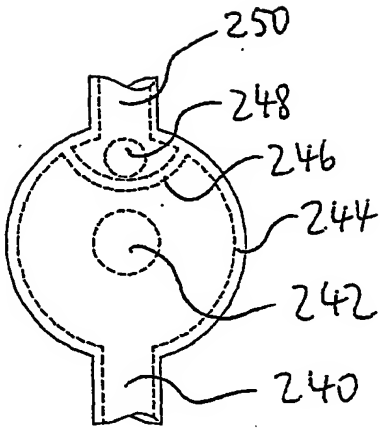

Fig. 27a

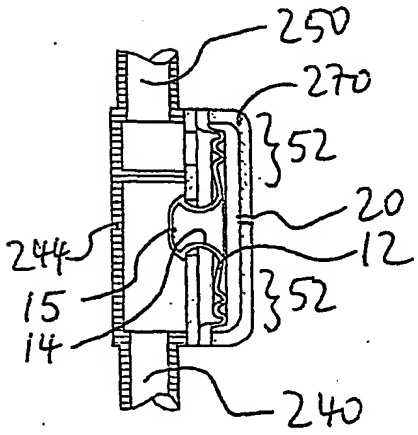

Fig. 27b

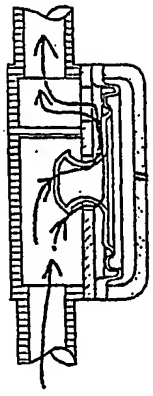

Fig. 27c

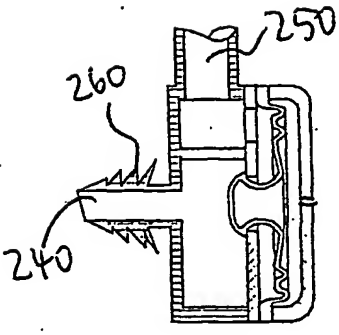

Fig. 27d

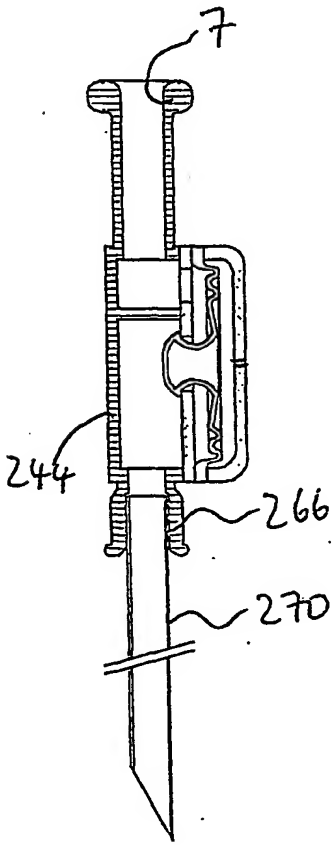

Fig. 27e

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 02/00198

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B65D 47/24, A47G 19/22
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B65D, A61J, A47G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A		2,3,6-10,12, 14,16
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X	US 4135513 A (KJELL O. ARISLAND), 23 January 1979 (23.01.79), figure 1	1,4,5,11,13, 15,16
A		2,3,6-10,12, 14
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P,X	WO 0192133 A2 (ESSEBAGGERS, JAN), 6 December 2001 (06.12.01), figures 7,8	1-16
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 October 2002	30-10-2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Anna Ahlander/Els Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 02/00198

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 4928836 A (MIN-YU WU ET AL), 29 May 1990 (29.05.90), figures 1-4	1-16
A	US 5607073 A (SCOTT M. FORRER), 4 March 1997 (04.03.97), figures 1-5	1-16
A	WO 9938423 A1 (CANNON RUBBER LIMITED), 5 August 1999 (05.08.99), figures 4,12	1-16

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/09/02

International application No.
PCT/NO 02/00198

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